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ADVANCED TECHNOLOGY AND EUROPEAN UNITY

Rene Bloch*

ABSTRACT. During the first forty years of the Twentieth Century, great scientific discoveries were still chiefly European; but in the last twenty five years, nearly all discoveries are coming to us from the United States of America. Creative power remains a necessity of human progress; but personal genius, unless associated with a well structured modern organization, is no longer sufficient to fully develop practical invention. The present superiority of our American friends, and our Soviet neighbour's potential development, challenge our ability to materialize our ideas. Thanks to the gradual awakening of some European conscience, we are getting a glimmer of hope and a first pledge, that our already successful cooperation will substantially promote European progress.

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On the ninth of August, three quarters of a century had passed since the day when — after five years of experiments with cambered airfoils, culminating in a gliding flight of three hundred fifty meters — Otto Lilienthal was the victim of an accident which brought his life to a premature close the next day.

Thus, before I have the great honor of addressing the German Society for Air and Space Travel and the French Association of Aeronautical and Space Engineers and Technicians this evening, I wished to travel the seventy

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**Numbers in the margin indicate pagination in the foreign text.

kilometers separating Berlin from Stoelln near Rathenow, in order to collect my thoughts at the place of this accident, and perhaps to find a last inspiration for this lecture. A frontier which you know only too well prevented it.

Symbolic of the most acute problems of our time, this idea of frontier leads me to devote my talk this evening to a subject greatly different from the highly technical ones which have been brought before this eminent assembly by my predecessors. I hope Otto Lilienthal, who devoted his life to these techniques, can pardon me if I speak neither of aerodynamics nor of flight mechanics.

Those of you who follow his mission in the areas of teaching, of research, or of industry know that if the spark of genius, creative power, remains the basis for all development and the necessary condition of all progress, it is not in itself a sufficient guarantee of success: the labor and organization necessary to exploit an invention, the faculty of innovating structures to realize profits — these have surely become complementary elements of technological and industrial progress, of financial and economic power — and how indispensible they are!

This power is in turn an essential factor in development, with the result that for a decade production of technological innovation is no longer only the driving element of the economy: it has become the very object of economic policy and sets off — except for accidents along the way — exponen- /6
tial growth in the whole related economic group.

Of these groups, the most important is made up of the United States of America, with a gross national product of about one trillion dollars in 1970. Tied for second place, with gross national products on the order of half this figure, are the Union of Soviet Socialistic Republics and the European Economic Community as we know it today. With a figure of about a quarter, the seven-nation group of the European Free-Trade Association has not known the success initially hoped for. As for national entities such as Japan, West Germany, or France, they presently achieve only a fifth or sixth of the

American product.

Have our two countries, and our neighbors likewise, done as they managed to do until the Second World War — have they succeeded in creating the advanced technologies needed for their own progress and for their foreign influence? Have they attained the human competences, the educational institutions, the technological means, the industrial structures, the financial resources for it? Are those things which cannot be realized on a national scale possible on the scale of Europe, and until Europe becomes united, through international co-operation within the framework of the Common Market? What are the advantages and limitations of such co-operation; what are the measures to be taken from the industrial standpoint and at the governmental level to promote it with success?

Such are some of the questions which I invite you to consider tonight, to which I propose to suggest certain answers, inspired as much by the successes as by the failures of the recent past, but in the face of which — to recall the words of a great President who once wished to be a great Berliner — it is important that in the future we be united and not divided.

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Why united? Because the three decades which separate us from the Twenty-First Century will witness accelerated development in all the scientific disciplines from which Europe cannot be absent through confiding its future either to the initiative of men or to the chance of circumstance — by leaving, as Machiaveli said, to "fortuna" the preponderant role in "virtu".

The great scientific discoveries of the first forty years of the Twentieth Century are to a very large extent the work of Europeans: Germans such as Einstein, Planck, and Domagk, French such as Curie, de Broglie, and Calmette, English such as Rutherford and Fleming, or Italians such as Fermi. Indeed, America is also present, with Taylor, Zwyorkin, Wiener, and Kendall, but less than one major invention in three came from across the Atlantic. Of one hundred forty-two Nobel Prizes in physics, chemistry, and medicine, one hundred sixteen went to Europeans.

All this changed twenty-five years ago: nearly all discoveries come to us from the United States, and the scientists of this country have carried off sixty-four of the one hundred thirty-three Nobel Prizes claimed between 1946 and 1970, nine more than all the countries of Western Europe together. Many of the laureates were of course born or educated in Europe. Thus, this year — during which your city has known the glory of seeing its former mayor, Chancellor Brandt, receive the Peace Prize — two scientists of German origin, Gabor and Herzfeld, have been crowned in physics and in chemistry.

If we find any consolation in this proof that fifty years ago European universities were best, we must however state that at present, out of one hundred young people between the ages of twenty and twenty-five, the number of university students is forty-three in the United States, twenty-four in Russia, sixteen in France, and only eight in West Germany. What do these numbers mean, if not our incapacity to fill the gap separating us from the superpowers, and also our apparent resignation to see this gap increase. Our first efforts must therefore be directed toward a substantial strengthening of our higher scientific and engineering teaching, which must not remain the prerogative of a minority, but must be opened wide to the investment which costs the least and returns the most: investment in people.

I know that it is not within the halls of the Technical University of Berlin that I will be contradicted on this point. I wish to add that this investment, of all those we can make, is that for which we have as much or even more of the raw materials than the superpowers, since — against two hundred eight million Americans and two hundred forty-six million Russians — the European Economic Community contains one hundred eighty-eight million inhabitants, and all of Western Europe, three hundred sixteen million.

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Let us return a moment to Dennis Gabor, Nobel-Prizewinner in physics in 1971, and to his invention: holography. As you all certainly know, a hologram is a photographic reproduction of the fringes from interference between rays reflected by an object and rays proceeding either from the initial light source or from reflection of the primary rays through the photographic emulsion. The

applications of holography range from three-dimensional television to computer memories, from anti-submarine warfare to medical diagnosis.

If holography, whose principle goes back to 1947, contains such possibilities today, it owes them to its association with an invention dating from 1958, the laser, which is perhaps the most important scientific discovery of the middle of this century, and whose possibilities open entirely new domains: for military use, ultra-precise telemetry today, perhaps the famous death-ray tomorrow; for civilian use, rock fusion, selective catalysis, multiplication of telecommunication channels, and computer miniaturization.

Speaking of computers, let us reflect an instant on the veritable electronic tempest which has burst on the world since the discovery of the transistor in 1948 — or better, since the invention a decade ago of integrated circuits: a /7 hundred-fold reduction in component prices, a thousand-fold increase in reliability, a ten-thousand-fold reduction in weight. Characterized by the dimensionless ratio of memory capacity to time required for execution of its elementary operation, the quality of a computer is presently being multiplied by ten every two or three years.

Although the first computer was built by Friedrich Zuse in 1941 right here in Berlin, these machines have at present become the true symbol of American power because of the preponderant place occupied in this area by the transatlantic industry, and also because henceforth electronic computing will dominate all of industry.

Holograms, lasers, computers: these techniques, picked almost at random, still show a supplementary aspect of modern progress: the reciprocal interaction which occurs among more or less simultaneous discoveries and accelerates their development. The most striking example of this phenomenon, which the Americans call by the Greek word synergism — we say today co-operation — is without doubt the Polaris program, whose accomplishment in less than ten years required simultaneous solution of six technical enigmas, each bearing on the others: nuclear propulsion and inertial guidance of the submarine, solid

propellant and miniaturization of the inertial guidance of the rocket, miniaturization of the thermonuclear warhead, conditioning its life during long submersion.

The phenomenon of synergism is a third factor adding to economic power and to educational effort which, unless we take care, can increase the gap separating the superpowers from the European nations. To meet this, there are two remedies: the first is a closer liaison between the various disciplines contributing to technological progress in a given area, a liaison established either at the initiative of the universities, or at that of the public authorities. These are the famous seminars of the other side of the Atlantic, during which, with the customary precautions, this artificial insemination is carried out at the learning level. As for the other remedy, it is a synergism of a special type: the progressive creation of (a unified) Europe.

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What then of the future of an industry which has as its triple characteristics the following: it alone is composed of a synthesis of almost all engineering disciplines; in almost every industrialized country it appears at the head of investments for research and development; it is doubtlessly of a little more interest to us tonight than the others: the aerospace industry?

In the area which until now was the mainstay of the activity of this industry, that of military equipment, basic research has made only little progress during the last years except in the matter of concept and integration of equipment. Ten years ago the main efforts of engineers were directed toward the study of hypersonic flight, of variable geometry, and of vertical take-off. Except for a few prototypes, we are at the same place as then. For want of a durable agreement with Great Britain, France has built by itself the Mirage V fighter and the G-8 bomber; perhaps for want of an agreement with West Germany, there are no follow-ons to the Mirage V and the VJ-101. If because of American engagement in Vietnam the transatlantic industry has also produced only a prototype with variable geometry, the F-14, it has nevertheless built a series of the trisonic SR-71 aircraft, whose performance is, however, equaled by the Russian MIG-23. Faced with these two aircraft, Europe still has not built an

engine capable of flight at Mach 3, and its engine industry, after being worn away in gut-fighting, is today undergoing the difficulties in developing it that the governments are in financing it.

To release the necessary funds, it is, however, sufficient to show that in the next several years almost all military requirements of our countries can be satisfied by four types of aircraft and two types of engine:

- a trainer equipped with an engine of two to three tons thrust;
- a one- or two-place tactical aircraft equipped with two of these engines;
- a one- or two-place interceptor equipped with one engine of nine to ten tons thrust;
- a multi-purpose aircraft with variable geometry equipped with two of these engines.

If the European countries can manage to agree that these aircraft be identical — as is only very partially true in certain present programs — the funds then available for future developments would allow all our delays to be made up.

To the four types of aircraft above, there will most surely be added those designed for military transport and anti-submarine warfare. Engaged side by side for thirteen years in the Atlantic and Transall programs, our two countries have been able to discover the advantages of co-operation. They have now, however, decided to modernize these aircraft or to replace them with material defined sufficiently early that in this area Europe will not again become tributary to foreign suppliers.

While the future of military aviation depends on governmental financing, progress in commercial aircraft corresponds to the ever-increasing desire of man to travel. Expressed in billions of passenger-kilometers, this desire was twenty-five in 1950, one hundred ten in 1960, four hundred seventy in 1970, and if it continues to double every four years, airlines will have to supply two trillion passenger-kilometers in 1980. To satisfy this need, four categories of aircraft are presently being studied or built: long-range supersonic craft,

long-range subsonic craft, medium-range craft, and aircraft for feeder lines.

Even before the first of these categories was considered, Europe, doubtlessly by its own fault, abandoned interest in the second: it can thus be asked whether sales of the Boeing 707 and the Douglas DC-8 would have reached the levels they did if Great Britain and France had united their construction efforts, using the same engine, only a French two-engine medium-range aircraft /8 such as the Caravelle, and an English four-engine long-range aircraft such as the VC-10.

The hard lesson seems to have borne fruit, since tomorrow — in three of the four categories mentioned — Europe will be present :

- with the French-English Concorde;
- with the medium-range French-German-Dutch Airbus, and the Mercure built by France, Belgium, Italy, and Spain;
- with the Caravelle, Fellowship, and BAC-111 for feeder lines.

In the area of long-range subsonic aircraft, it is probable that our absence will be long if not definitive, due to the recent appearance of the Boeing 747.

A non-negligible addition to the preceding construction, the production of business aircraft, has presented many problems to European industries up to now, because of its close dependence on the economic outlook. The United States, although it now builds only half of the fifteen thousand aircraft which it built formerly (because of the Vietnam crisis), represents such competition that without radical restructuring of European production, the latter will, with a few exceptions such as two-engine planes carrying a dozen passengers, be required to disappear or to submit to construction under American license.

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Completely inseparable from aeronautical construction, the building of military engines will henceforth occupy almost as large a place in the research laboratories and manufacturing shops as aircraft.

Tactical missiles, more and more highly developed, by their variety make one think of the munitions of old and of the American arsenal, the Soviet arsenal, as well as of the European arsenal built in almost every area through co-operation. They come in about forty types: nearly-instantaneous surface-to-air missiles, infra red-seeking air-to-air missiles, air-to-surface missiles with anti-radar capability, self-guiding surface-to-surface missiles, and even anti-submarine missiles. The most complete choice is now at the disposal of the general staffs.

As for strategic missiles, now available either as ground-to-ground rockets stored in silos or as sea-to-ground rockets carried aboard nuclear submarines, or tomorrow launched from military satellites, they represent a form of absolute weapons both because of their range and because of their megaton warheads. Their construction employs the indispensible contribution of the technological and industrial capabilities of the nation which decides to supply itself with them, and requires a capability in atomic energy, in electronics, and in propulsion which up to now only three, or perhaps four, countries have achieved. I remind you that the most powerful of these rockets is the Russian SS-9 which uses liquid fuel and can launch a twenty-megaton warhead at a target ten thousand kilometers away. The most modern is without doubt the American solid-fueled Minuteman 3, capable of attacking simultaneously several objectives at a distance of twelve thousand kilometers thanks to a multiple warhead. It is also suitable to mention the existence of anti-missle missiles such as the Soviet SA-7 already deployed around Moscow, and the American Spartan and Sprint projects, designed to use a warhead of several tens of megatons to neutralize a volume sufficient to destroy a missile found in it.

To complete this rapid fresco of current projects in the aerospace industry, only space itself is lacking. The exploits of the American Mercury, Gemini, and Apollo, and of the Russian Vostok, Voskhod, and Soyuz, as well as the current presence of the American Mariner 9 probe in orbit around Mars, are too present in our minds for us not to feel literally overwhelmed. Just the mention of the lift-off thrust of the Saturn rocket — three thousand four hundred twenty-nine tons — gives us an idea of the road to be traveled. The

unhappy failure of the Europa 2 rocket last November 5 is no comfort to us.

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Trisonic aircraft and engine, anti-submarine aircraft and armament systems; long- and medium-range commercial transports, business aircraft, tactical missiles, space politics: so many areas in which the recent past proves the inanity of the scattered European efforts, and contrariwise spotlights the possibilities of co-operation. Instead of a long discourse, I shall let the sober eloquence of figures underline this situation: in 1970, the volume of business of the American aerospace industry represented ten times that of its homologue in the European Economic Community, and five times that of the aerospace industry in all of Western Europe. During the same year, America spent ten times more than Europe for the conquest of space.

To the extent that such a ratio of strengths can convince the European governments and industries of the necessity of uniting their efforts, there appears to be an alternative between the highest possible specialization by each country in the disciplines in which it excels, and simultaneous division of responsibilities in several projects. The first of these choices corresponds to the Swiss and Swedish solutions, but presents the danger of all monocultures; furthermore, no government will accept disinterest in a program which touches the vital interests of its national policies. Attendant on the creation of a true European nation, co-operation will be condemned to take one of the forms which have developed over the last fifteen years. But are all these forms equivalent?

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Let us take up the case of space again.

Realizing that all the space budgets of Western Europe ten years ago were only one thirtieth of the NASA budget, some three hundred societies banded together as Eurospace to act in concert with their governments. /9 Conscious of the important contribution to American technological progress of the returns from space research, and of the role that satellites will be called upon to play in telecommunications, these industrialists could not accept renouncement by Europe which, in an area of such importance, would no longer be merely a

technological or economic fact, but a political and historic gesture. Eurospace decided on creation of a central authority co-ordinating completely all initiatives and eliminating at once both gaps and duplicated effort. This wish can scarcely be granted.

The first objective fixed by ELDO, the new European space authority, was simple: to place in a five hundred-fifty kilometer circular orbit around the earth a payload of eight hundred kilograms, the conservative date being 1965, the budget one hundred ninty-six million dollars. But difficulties began right from the start:

- before any preliminary study, Great Britain imposed the Blue Streak as the first stage; it had not been used since cancellation of the corresponding military program;
- the satellite was placed under the responsibility of a separate organization, ESRO;
- finally, no governmental body co-ordinates the action of the industrialists, which therefore resembles a juxtaposition more than an integration.

The results were not as expected: the so-called "French" crisis in 1965 and the "English" in 1966, delay in the specifications — payload reduced by half — a six-year delay in completion and multiplication of the budget by three. A new crisis occurred in 1970 for similar reasons emerging from the decision of certain countries to withdraw and the formation of a France-Germany-Belgium-Netherlands nucleus, which decided to go it alone if there would be no European policy. This effort is even more indispensible, since it has become evident that the United States — although initially placing its launchers at the disposal of the European nations — decided to retain complete control of satellite telecommunications, despite a certain facade of concessions.

Deceived by this evolution, with the greatest part of their space budget now outside the common program, will our governments thus go from technological crisis to political crisis until the independence of Europe in space is compromised for all time?

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It is perhaps a pity that co-operation in space could not or would not profit from the experience of aeronautical co-operation which had begun some years earlier. Indeed, all co-operation has its difficulties, in the first rank of which are the human problems and the linguistic barriers. But since the anglo-saxon countries have adopted the metric system, units are no more than a tooling difficulty. Judicial statutes, social rules, and contractural practices have become more and more similar, and commercial legislations are adapting to transactions on a world-wide scale. Even the differences among the administrative regulations or among the systems of taxes and customs can now be tamed.

On the other hand, two problems remain, and will remain as long as there will be divergent interests in economic or national areas:

- the deep-seated motives of a national policy can be served only imperfectly by even a friendly government: total co-operation is truly total only under the pressure of external political events;
- because of the imperatives of the entire national economy and of the necessity to maintain a high level of employment, nations can see themselves constrained to refuse co-operation despite the advantages it would present.

But to the extent that political willingness can remove this double difficulty, co-operation becomes a procedure which, as every other, has directing principles which must be known to be respected. These principles have not been invented out of the blue. They have been established progressively during the execution of many projects, and more particularly during a program sometimes cited as an example: the Atlantic.

The first of these principles is that every program must rest on a fundamental trilogy — engineering specifications, scheduling, budget — for which initial precision and permanent respect condition the final success. In the special case of international co-operation, it is preferable that this specification and the operational program from which it proceeds be unique.

The second principle refers to the governmental and industrial organization of the co-operation. The formula of an Executive Committee, to which each associated government delegates a representative provided at the international level with a very large delegation of powers and responsible at the national level for the co-ordination of interested departments, seems so widely adopted that it is now needless to justify it. At most, it is expedient to insist on the choice of an existing national administrative body as the executive agency in preference to an international agency which would first have to be created, then given a chance to work freely, and which would be very expensive to dissolve again, while such bodies often seek to survive at any price. Organized in a manner symmetric to that of the governments, co-operation among industrialists has the advantage, starting with fundamental options being decided at the level of an international Council, that it is carried out under the responsibility of a single executive, assurring to each its just and equitable participation in the common work.

The third and most important of these principles comes from the economy. At a time when the problem of international balance of payments is in the first rank of preoccupations in the economic sphere, even taking precedence over concerns for growth of the national product and balance of the national budget, it is important that the distribution of tasks among the countries participating in the program be proportional to the initial risks and to the financial burdens /10 assumed by the governments.

This last principle — sometimes called "just return" — has a counterpart less often evoked but perhaps more important, which the European Economic Community has defined a long time ago in other areas: every association involves the obligation to accord preferential treatment to its partners. But on two levels at least, particularly critical for what concerns us here, this principle is not respected very much:

- the obligation of airlines to remain competitive quite often leads them to buy American aircraft, even when the European industry is able to satisfy them. It is up to the governments not to restrict the freedom of action or the efficiency of the transportation companies in this

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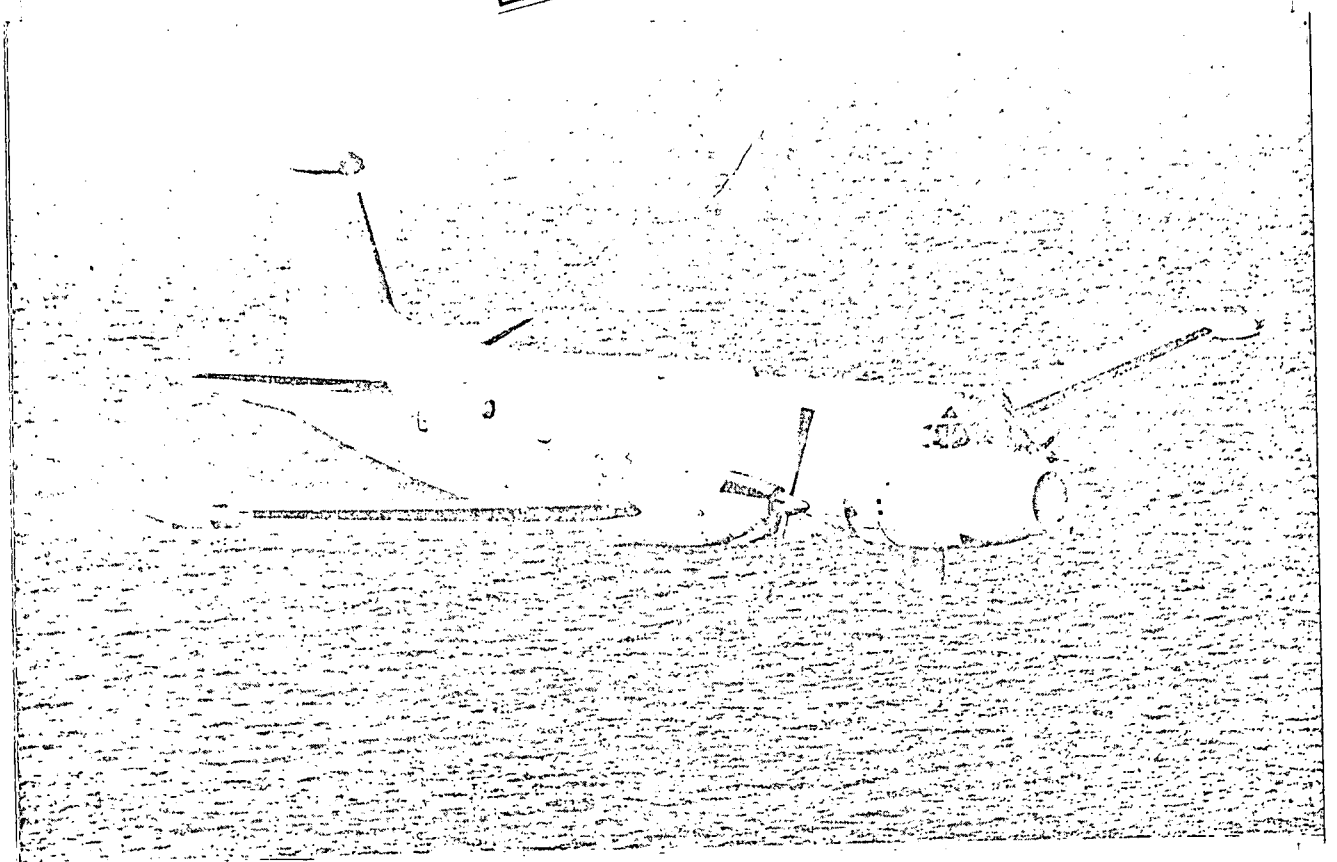

The Breguet 1150 "Atlantic" is a noteworthy example of European co-operation; it has been adopted by all the countries of the Common Market. 87 have been ordered: 40 by France, 20 by Germany, 18 by Italy, and 9 by The Netherlands. The 65th Atlantic was delivered to The Netherlands in February.

respect, but to bring about at the right time and to maintain permanently the necessary liaisons and sufficient catalytic effect that European material will be adopted by our airlines;

- the habit of offset practiced by our closest allies leads to devoting a large part of European resources to the purchase of material of a

highly advanced technology from suppliers who, to be friends, are not serious competitors.

It is particularly important to end these last practices progressively, these friends really act as competitors. American exports to the European Economic Community, which were less than three billion dollars in 1958, reached nine billion in 1970 and represent two-thirds of the surplus in the American commercial balance. Despite this, despite a supplementary revenue of more than eleven billion dollars from American investments in Europe, the United States dealt us a hard blow by the decision of August 15, 1971, since which date the dollar is no longer supported by the economy, but rather by American politics.

If, as we all hope, Europe will someday succeed in raising itself to the level of the superpowers, don't you think our grandchildren will laugh when we tell them that there was a time when three hundred million Europeans were so afraid of two hundred fifty million Russians that they had not only called to their aid two hundred million Americans, but even sacrificed to the demands of these latter their one chance not to fear the Russians any longer?

Renovated education, improved information exchange, transformation of the methods of association among industries, on the one hand, and governments, on the other, choice of large operations preserving in essentials the autonomy of Europe, management of community programs by bodies holding a minimum of federal power — such are the first guideposts of the reconquest of our technological independence, an indispensible prelude to development of consciousness of a new form of European civicism. That is what General de Gaulle called European Europe.

The superiority of our American friends and the potential of our Soviet neighbors stand accused before all our intellectual fertility and our aptitude to transform our ideas into realities. What is risked by yielding to this superiority or this potential are both our political structures and our mental structures, or to put it otherwise, our entire culture. If during the few decades which separate us from the Twenty-First Century — and preferably ten

years from now — we have not accomplished the mutation which is required, the monopoly of science, of technology, and of power will permanently pass over the Atlantic. This would be an unacceptable situation for Europe, formidable for America itself, and disasterous for the world.

Thus, if the variety of possible options within a collectivity, the equilibrium of forces and counter-forces, the competition of initiatives are irreplacable factors of progress and liberty, they are even more so on the international scale. With a monopoly on advanced civilization, the United States could not help making of this superiority a sort of sacred duty pointing out the single and obligatory direction to which the rest of the world would be bound behind it. America, losing the stimulant and the correction of competition, could only multiply the risks of error and deterioration, and, furthermore, is beginning to show disquieting symptoms of them. It is therefore not an exaggeration to say that Europe holds in its hands more than its own destiny.

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If the failure of an artificially supernational Europe was in the nature of things, the progressive creation of a European consciousness represents in contrast not only a gleam of hope but a guarantee of the future, to which the successes gained at the present time by co-operative programs contribute appreciably. Whatever the human, technological, and economic diversities among our countries could have been, it is undeniable that — thanks to more numerous journeys abroad, to exchanges of our young people, to liaisons among our enterprises and our syndicates, and finally to our economic development — a certain idea of the European value, as opposed to other values, is dawning.

From this moment it is important for each of our countries — in particular, for West Germany, Great Britain, and France — to take up certain options which relate to both economics and politics: perhaps the basic option to be grasped lies in making politics triumph over economics and solidarity over egotism. Europe cannot be formed in a worry over neutrality or for a desire for commerce. Its independence must inspire more noble goals than the growing of grain or the improvement of railways, and the future of three hundred million people justifies seeking a certain influence. Cradle of civilizations,

enriched by so many unhappy experiences, Europe must make its independence a grand and glorious ambition at the service of a grand ideal.

All you who have met here tonight must be more at the service of this ideal than other people, because you are the men responsible for the most beautiful of the advanced technologies which are making our future, because you are men whose presence here at the outposts of liberty proves your desire and your courage, and because it is men such as you who are the best guarantors of the Europe of tomorrow.